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NEW UTILITY PATENT APPLICATION TRANSMITTAL
(Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No. YO9-98-466
Total Pages in this Submission

TO THE ASSISTANT COMMISSIONER FOR PATENTS
Box Patent Application
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

PROGRESSIVE ADAPTIVE TIME STAMP RESOLUTION IN MULTIMEDIA AUTHORING

and invented by:

Michelle Y. Kim and Peter H. Westerink

If a CONTINUATION APPLICATION, *check appropriate box and supply the requisite information:*

☐ **Continuation** ☐ **Divisional** ☐ **Continuation-in-part (CIP)** of prior application No.: _____

Enclosed are:

Application Elements

1. ☒ Filing fee as calculated and transmitted as described below

2. ☒ Specification having **18** pages and including the following:

   a. ☒ Descriptive Title of the Invention

   b. ☐ Cross References to Related Applications *(if applicable)*

   c. ☐ Statement Regarding Federally-sponsored Research/Development *(if applicable)*

   d. ☐ Reference to Microfiche Appendix *(if applicable)*

   e. ☒ Background of the Invention

   f. ☒ Brief Summary of the Invention

   g. ☒ Brief Description of the Drawings *(if drawings filed)*

   h. ☒ Detailed Description

   i. ☒ Claim(s) as Classified Below

   j. ☒ Abstract of the Disclosure

3. ☒ Drawing(s) *(when necessary as prescribed by 35 USC 113)*

   a. ☐ Formal

   b. ☒ Informal

   Number of Sheets **5**

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Application Elements (Continued)

4. ☒ Oath or Declaration
   a. ☒ Newly executed *(original or copy)* ☐ Unexecuted
   b. ☐ Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional application only)*
   c. ☒ With Power of Attorney ☐ Without Power of Attorney

5. ☐ Incorporation By Reference *(usable if Box 4b is checked)*
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ☐ Computer Program in Microfiche *(Appendix)*

7. ☐ Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all must be included)*
   a. ☐ Paper Copy
   b. ☐ Computer Readable Copy *(identical to computer copy)*
   c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

Accompanying Application Parts

8. ☒ Assignment Papers *(cover sheet & document(s))*

9. ☐ 37 CFR 3.73(B) Statement *(when there is an assignee)*

10. ☐ English Translation Document *(if applicable)*

11. ☒ Information Disclosure Statement/PTO-1449 ☒ Copies of IDS Citations

12. ☐ Preliminary Amendment

13. ☒ Acknowledgment postcard

14. ☐ Certificate of Mailing
    ☐ First Class ☐ Express Mail *(Specify Label No.):* **HAND DELIVERED**

15. ☐ Certified Copy of Priority Document(s) *(if foreign priority is claimed)*

NEW UTILITY PATENT APPLICATION TRANSMITTAL
(Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No. YO9-98-466
Total Pages in this Submission

Accompanying Application Parts (Continued)

16. ☐ Additional Enclosures *(please identify below):*

Fee Calculation and Transmittal

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	4	- 20 =	0	x $18.00	$0.00
Indep. Claims	1	- 3 =	0	x $78.00	$0.00
Multiple Dependent Claims (check if applicable) ☐					$0.00
				BASIC FEE	$760.00
OTHER FEE *(specify purpose)* _____					$0.00
				TOTAL FILING FEE	$760.00

☐ A check in the amount of to cover the filing fee is enclosed.

☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. **50-0510** as described below. A duplicate copy of this sheet is enclosed.

- ☒ Charge the amount of **$760.00** as filing fee.
- ☒ Credit any overpayment.
- ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

Dated: **November 30, 1998**

Signature

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APPLICATION FOR UNITED STATES LETTERS PATENT

Applicants: Michelle Y. Kim and Peter H. Westerink
For: PROGRESSIVE ADAPTIVE TIME STAMP RESOLUTION IN MULTIMEDIA AUTHORING
Docket No.: YO9-98-446

PROGRESSIVE ADAPTIVE TIME STAMP RESOLUTION IN MULTIMEDIA AUTHORING

CROSS-REFERENCE TO RELATED APPLICATION

This application is continuation-in-part of provisional patent application Serial No. 60/106,764 filed November 3, 1998, the benefit of the filing date of which is hereby claimed for the commonly disclosed subject matter.

DESCRIPTION

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention generally relates to composing and playing multimedia presentations and, more particularly, to a flexible time stamp information carried in the stream descriptor of the multimedia presentation.

Background Description

Multimedia authoring systems exist that allow the user (i.e., the author) to insert multimedia objects, such as video, audio, still pictures, and graphics, into a multimedia presentation at a certain spatial position and with a certain temporal location. Such an authoring system is used typically to create presentations that are in an MPEG-4 (Motion Picture Experts Group, version

4) or SMIL (Synchronized Multimedia Integration Language) format.

In more advanced authoring systems, the temporal location of the multimedia objects need not be absolute in time, but can be defined relative to other multimedia objects. This means that, for example, a video clip can be authored to start at the same time that a specific audio clip starts. Another such example is that after completely playing a certain video clip, another video clip should be played, possibly with some delay. The essence of this is that multimedia objects have start and end times that are defined with respect to the start and end times of other multimedia objects, with possible temporal offsets (delays).

A further feature of advanced temporal authoring of multimedia objects is the possibility to have a range in duration of multimedia objects. For example, a certain video clip has a certain duration when played at the speed at which it was captured, say thirty frames per second. This now allows authors to define a range in the playback speed, for example between fifteen frames per second (slow motion by a factor of two) and sixty frames per second (fast play by a factor of two). This results in respectively a maximum and minimum total playback duration. In general, the advanced authoring systems allow authors to specify such ranges in multimedia object playback duration. Note, that it is still possible to dictate only one specific playback duration (which is directly related to the playback speed in the case of video, audio, or animation) by restricting the duration range to a zero width.

If we now combine the relative start and end times of multimedia objects in the authoring system with the possibility to also specify a duration range, we see that a complete authored multimedia presentation is a complex but flexible system of interconnected objects with variable durations. The advantage of having this flexibility in duration lies in the data transmission

and playback of multimedia objects. By not having very strict multimedia start and end times, the system has some flexibility to adapt to data delivery problems, which may be due to network congestion or transmission errors. For the final delivery and playback the system (which may be the server or the client) will resolve the true multimedia object start and end times during transmission and playback adaptive to the environment.

In general, with these variable object durations, many actual values for start and end time are possible for all of the multimedia objects, especially when no delivery problems occur. In actual playback, absolute time stamps must be used. That means that for every multimedia object a playback duration is chosen which lies within the range of its possible durations. The problem of determining these factual durations at run time (i.e., playback) is addressed here. The method will be progressive in time; that is, it resolves the absolute time stamps as time advances, making it adaptive to the changing environment. Finally, it must be defined what information is to be sent to a client, that is sufficient to do the time stamp resolution.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a technique for determining the factual durations of multimedia objects at run time

It is another object of the invention to provide a new dedicated descriptor of object time duration to alleviate the problem of unreliable delivery of objects in a multimedia presentation.

According to the invention, the solution to the problem consists of two parts. First, it is necessary to define what information must be available to the client in order to be able to determine the multimedia object durations. And

second, the resolution of the durations themselves must be solved. The new flexible timing information can be used by the client to adapt the timing of the ongoing presentation to the environment, while having more room to stay within the presentation author's intent and expectations.

Six steps are used to resolve the actual label time, and the corresponding duration of the multimedia objects that have that label for their respective end times. In the first step, all the dependency relations are collected for the label Px, by taking all objects n that have Px as the label for their end time:

$$t_n + \text{minimum}(n) \le t_x \le t_n + \text{maximum}(n) \quad n = 1, \ldots, N$$

Here t_n is the start time of object n, and N is the number of objects.

In the second step, the N relations are used to calculate the tightest bounds on t_x:

$$\min\{t_x\} \le t_x \le \max\{t_x\}$$

with

$$\min\{t_x\} = \max\{t_n + \text{minimum}(n)\} \quad n = 1, \ldots, N$$

$$\max\{t_x\} = \min\{t_n + \text{maximum}(n)\} \quad n = 1, \ldots, N$$

In the third step, the bounds on the durations of each object n are recalculated by using:

$$\text{duration}(n) = t_x - t_n$$

to get

$$\min\{t_x\} - t_n \le \text{duration}(n) \le \max\{t_x\} - t_n \quad n = 1, \ldots, N$$

In the fourth step, the preferred duration of each object n is recalculated:

if (preferred(n) < $\min\{t_x\} - t_n$) then

preferred(n) = $\min\{t_x\} - t_n$

else if (preferred(n) > $\max\{t_x\} - t_n$) then

$$\text{preferred}(n) = \max\{t_x\} - t_n$$

end if

In the sixth step, the general error criterion for resolving the duration of each multimedia object is defined as:

$$E = \sum_{n=1}^{N} \{\text{duration}(n) - \text{preferred}(n)\}^2$$

or, substituting $\text{duration}(n) = t_x - t_n$:

$$E = \sum_{n=1}^{N} \{t_x - t_n - \text{preferred}(n)\}^2$$

If we take the derivative of E with respect to t_x, and set this to 0, we see that the optimal solution for the absolute time t_x of label Px is:

$$t_x = \frac{1}{N}\sum_{n=1}^{N} \{t_n + \text{preferred}(n)\}$$

Finally, in the sixth step, the corresponding duration of multimedia object n is calculated with:

$$\text{duration}(n) = t_x - t_n$$

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, aspects and advantages will be better understood from the following detailed description of a preferred embodiment of the invention with reference to the drawings, in which:

Figure 1 is a block diagram of one preferred computer system with multimedia inputs and outputs that uses the method of the present invention;

Figure 2 is a temporal diagram illustrating the problem solved by the present invention;

Figure 3 is a flow diagram showing the logic of the overall process according to the invention;

Figure 4 is a flow diagram showing the logic of the process for calculating the minimum and maximum times in block 302 of Figure 3;

Figure 5 is a flow diagram showing the logic of the process for calculating t_x in block 303 in Figure 3; and

Figure 6 is a flow diagram showing the logic of the process for calculating the durations of the objects in block 304 of Figure 3.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring now to the drawings, and more particularly to Figure 1, there is shown in block diagram form a computer system 100 on which the subject invention may be practiced. The computer system 100 includes a personal computer (PC) 105 running a windowing operating system and including a multimedia audio/video capture adaptor 110. A video camera 122 connects to the adaptor 110 as does an optional playback monitor 124 for multimedia presentations composed on the computer system 100. Other multimedia hardware 130 may be included as well as various input devices, such a keyboard (not shown), a cursor pointing device (e.g., a mouse) (not shown) and a microphone 132 or other audio input device, and a monitor 134 on which a graphic user interface (GUI) of the operating system and application software is displayed. The computer 105 includes secondary memory storage (e.g., a hard drive) 140 of adequate capacity to store the multimedia

presentation being authored.

The solution to the problem outlined above is best illustrated by a simple example. Let us consider a presentation that is authored having three multimedia objects, a video clip (V), an audio clip (A), and a background image (B). As explained above, the Isis authoring system requires the author to specify for each multimedia object the duration range, as well as a relative start and end time. For the three objects in our exemplary presentation, the parameters are authored as:

	start	end	minimum duration	preferred duration	maximum duration
V	P1	P2	3 seconds	4 seconds	5 seconds
A	P2	P3	3 seconds	4 seconds	4 seconds
B	P1	P3	7 seconds	7 seconds	8 seconds

The labels P1, P2, and P3 are to indicate how the various multimedia objects are temporarily related. This means, for example, that objects V and B start at the same time. The temporal aspect of this authored presentation can be depicted more clearly in Figure 2.

As shown in Figure 2, the background image B starts a point P1 and ends at a point P3. The duration times are shown in brackets as 7,7,8 corresponding to 7 seconds minimum duration, 7 seconds preferred duration, and 8 seconds maximum duration. Similarly, the video clip V begins at the point P1 and ends at a point P2, and the audio clip A begins at the point P2 and ends at the point P3, again with duration times shown in the brackets.

The player (the client) of the multimedia presentation first receives the multimedia object parameters for video clip V and background B. The player

then initializes the time of point Pl (arbitrarily) to t_1=0, and starts playing the two objects V and B with their preferred duration. For the video clip V, this means it will be played at the corresponding preferred speed. If no network or playback delays occurred, the video will finish after four seconds. However, if a delay of ½ second occurred during playback, the time of point P2 is not t_2=4, but t_2=4.5. The player next attempts to resolve the durations of B and A. It does this using the relations:

$$t_1 + 7 \le t_3 \le t_1 + 8$$
$$t_2 + 3 \le t_3 \le t_2 + 4$$

Knowing that t_1=0 and t_2 =4.5, we obtain:

$$7 \le t_3 \le 8$$
$$7.5 \le t_3 \le 8.5$$

Which is combined into:

$$7.5 \le t_3 \le 8$$

With this we can recalculate the duration range for both the background B and audio clip A. Using:

$$\text{duration(B)} = t_3 - t_1 = t_3$$
$$\text{duration(A)} = t_3 - t_2 = t_3 - 4.5$$

we get

$$7.5 \leq \text{duration(B)} \leq 8.0$$

$$3.0 \leq \text{duration(A)} \leq 3.5$$

We next use these new duration ranges to redefine the preferred durations of both audio clip A and background B. For background B, we see that the preferred duration cannot be met, and we have to settle for the closest value to the preferred value, which is now 7.5 seconds. Similarly, the preferred duration for the object audio clip A changes to 3.5 seconds:

$$\text{preferred(B)} = 7.5$$

$$\text{preferred(A)} = 3.5$$

Finally, we can use these now feasible preferred durations to determine a good value for the time t_3 at point P3, and thus for the durations of the objects B and A. We do this by defining an error criterion on the durations as the sum of the squared deviations from the (updated) preferred durations:

$$E = \{\text{duration(B)} - \text{preferred(B)}\}^2 + \{\text{duration(A)} - \text{preferred(A)}\}^2$$

Using the definitions of the durations from above, and the recalculated preferred durations, this is rewritten into:

$$E = \{t_3\text{-}7.5\}^2 + \{t_3\text{-}4.5\text{-}3.5\}^2 = \{t_3\text{-}7.5\}^2 + \{t_3\text{-}8.0\}^2$$

Minimizing this error with respect to t_3 simply yields:

$$t_3 = \tfrac{1}{2}(7.5+8.0) = 7.75$$

and the durations are

duration(B) = 7.75

duration(A) = 3.25

From this example, it will be understood that the solution to the problem consists of two parts. First, it is defined what information must be available to the client in order to be able to determine the multimedia object durations. And second, the resolution of the durations themselves must be solved.

A client (i.e., player of the multimedia presentation) must receive for each multimedia object five items of information. These items are the two labels, one for the object's start time and one for the end time, and the three durations, the minimum, maximum, and the preferred duration. In the case of video, audio, and other multimedia objects that have a playback speed, the preferred duration must correspond to the "regular" playback speed of the object. The information on a particular multimedia object must be delivered to the client prior to starting playback of the object.

When playback has finished for a particular multimedia object, the absolute time of a certain label will become known. This means, that one or more label times can be resolved using this new information. The time stamp resolution is therefore progressive over time, as more information becomes available in the form of factual multimedia object durations, and arrival of information of objects that are to be played in the (near) future.

To resolve the actual label time, and the corresponding duration of the multimedia objects that have that label for their respective end times, the following steps are taken:

1. Collect all the dependency relations for the label Px, by taking all objects n that have Px as the label for their end time:

$$t_n + \text{minimum}(n) \le t_x \le t_n + \text{maximum}(n) \quad n = 1, \ldots, N$$

Here t_n is the start time of object n, and N is the number of objects.

2. Use the N relations to calculate the tightest bounds on t_x:

$$\min\{t_x\} \le t_x \le \max\{t_x\}$$

with

$$\min\{t_x\} = \max\{t_n + \text{minimum}(n)\} \quad n = 1, \ldots, N$$

$$\max\{t_x\} = \min\{t_n + \text{maximum}(n)\} \quad n = 1, \ldots, N$$

3. Recalculate the bounds on the durations of each object n, by using:

$$\text{duration}(n) = t_x - t_n$$

to get

$$\min\{t_x\} - t_n \le \text{duration}(n) \le \max\{t_x\} - t_n \quad n = 1, \ldots, N$$

4. Recalculate the preferred duration of each object n:

if (preferred(n) < $\min\{t_x\} - t_n$) then

preferred(n) = $\min\{t_x\} - t_n$

else if (preferred(n) > $\max\{t_x\} - t_n$) then

preferred(n) =$\max\{t_x\} - t_n$

end if

5. The general error criterion for resolving the duration of each multimedia object is defined as:

$$E = \sum_{n=1}^{N} \{\text{duration}(n) - \text{preferred}(n)\}^2$$

or, substituting $\text{duration}(n) = t_x - t_n$:

$$E = \sum_{n=1}^{N} \{t_x - t_n - \text{preferred}(n)\}^2$$

If we take the derivative of E with respect to t_x, and set this to 0, we see that the optimal solution for the absolute time t_x of label Px is:

$$t_x = \frac{1}{N}\sum_{n=1}^{N} \{t_n + \text{preferred}(n)\}$$

6. The corresponding duration of multimedia object n is calculated with:

$$\text{duration}(n) = t_x - t_n$$

The entire process of steps 1 through 6 is summarized as illustrated in Figure 3. The inputs to the process as in step 1, *supra*, are shown at block 301. Step 2 calculates the minimum and maximum end times over all multimedia objects in function block 302. This is described in more detail in the description of Figure 4, *infra*. Next, the steps 3, 4 and 5 are combined in function block 303. This is described in more detail in the description of Figure 5, *infra*. Finally, the durations of the objects are calculated in function block 304, which is described in more detail in the description of Figure 6, *infra*.

Step 2 (i.e., block 302 of Figure 3) is illustrated more detail in Figure 4. The process is initialized in function block 401 before entering the processing loop. The value of n is incremented by one in function block 402 at the beginning of the processing loop. A test is made in decision block 403 to determine if the minimum end time is less than the start time of object n plus the minimum duration of object n. If so, the minimum time is set to that value in function block 404. If not, a test is made in decision block 405 to determine if the maximum end time is greater than the start time of object n plus its maximum duration. If so, the maximum time is set to that value in function block 406. Finally, a test is made in decision block 407 to determine if all

objects have been processed and, if not, the process loops back to function block 402 where the value of n is again incremented, and the maximum and minimum times for the next multimedia object are calculated. This processing continues until the minimum and maximum end times over all N multimedia objects have been calculated.

Steps 3, 4 and 5 (i.e., block 303 in Figure 3) are illustrated in more detail in Figure 5. The process is initialized in function block 501 before entering the processing loop. The value of n is incremented by one in function block 502 at the beginning of the processing loop. A test is made in decision block 503 to determine if the preferred duration is greater than the minimum end time less the start time of a current object n. If not, the preferred duration is set to this value in function block 504; otherwise, a further test is made in decision block 505 to determine if the preferred duration is less than the maximum end time less the start time of the current object n. If not, the preferred duration is set to this value in function block 506; otherwise, the preferred duration is set to the preferred duration of the object n in function block 507. Then, in function block 508, the sum of the times is calculated. A test is made in decision block 509 to determine if all objects have been processed and, if not, the process loops back to function block 502 where the value of n is again incremented. When all objects have been processed, the time t_x is computed as the sum divided by N, the number of the multimedia objects, in function block 510.

Step 6 (i.e., block 304 in Figure 3) is shown in more detail in Figure 6. The process begins by initializing n to zero in function block 601. The value of n is incremented by one in function block 602 at the beginning of the processing loop. The duration of each object n is calculated in function block 603 as the calculated time t_x minus the start time $t(n)$ of the object n. After

each calculation, a test is made in decision block 604 to determine if all objects have been processed. If not, the process loops back to function block 602 where *n* is again incremented and the duration of the next object is calculated. The process ends when all *N* objects have been processed.

While the invention has been described in terms of a single preferred embodiment, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the appended claims.

CLAIMS

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

1. A method of progressive time stamp resolution in a multimedia presentation comprising the steps of:

supplying a player of a multimedia presentation with information comprising two labels, one for a multimedia object's start time and one for the multimedia object's end time relative to other multimedia object start and stop times, and three durations, a minimum duration, a maximum duration and a preferred duration for each multimedia object prior to starting playback of the multimedia object; and

resolving the durations of multimedia objects using said information based on actual multimedia object durations and arrival of information of multimedia objects to be played.

2. The method of progressive time stamp resolution in a multimedia presentation recited in claim 1 wherein the step of resolving comprises the steps of:

calculating minimum and maximum end times for over all multimedia objects;

calculating actual end times that are shared by all multimedia objects; and

recalculating a preferred duration of each multimedia object.

3. The method of progressive time stamp resolution in a multimedia presentation recited in claim 1 wherein the step of resolving comprises the steps of:

collecting all the dependency relations for the label Px, by taking all objects n that have Px as the label for their end time:

$$t_n + \text{minimum}(n) \le t_x \le t_n + \text{maximum}(n) \quad n = 1, \ldots, N$$

where t_n is the start time of object n, and N is the number of objects;

using the N relations to calculate the tightest bounds on t_x:

$$\min\{t_x\} \le t_x \le \max\{t_x\}$$

with

$$\min\{t_x\} = \max\{t_n + \text{minimum}(n)\} \quad n = 1, \ldots, N$$

$$\max\{t_x\} = \min\{t_n + \text{maximum}(n)\} \quad n = 1, \ldots, N;$$

recalculating the bounds on the durations of each object n, by using:

$$\text{duration}(n) = t_x - t_n$$

to get

$$\min\{t_x\} - t_n \le \text{duration}(n) \le \max\{t_x\} - t_n \quad n = 1, \ldots, N; \text{ and}$$

recalculating the preferred duration of each object n according to the process:

if (preferred(n) < $\min\{t_x\} - t_n$) then

preferred(n) = $\min\{t_x\} - t_n$

else if (preferred(n) > $\max\{t_x\} - t_n$) then

preferred(n) =$\max\{t_x\} - t_n$

end if.

4. The method of progressive time stamp resolution in a multimedia presentation recited in claim 3 wherein the step of resolving further comprises the steps of:

using as the general error criterion for resolving the duration of each multimedia object:

$$E = \sum_{n=1}^{N} \{\text{duration}(n) - \text{preferred}(n)\}^2$$

or, substituting $\text{duration}(n) = t_x - t_n$:

$$E = \sum_{n=1}^{N} \{t_x - t_n - \text{preferred}(n)\}^2$$

and taking the derivative of E with respect to t_x, and setting this to 0 to obtain the optimal solution for the absolute time t_x of label Px as:

$$t_x = \frac{1}{N}\sum_{n=1}^{N} \{t_n + \text{preferred}(n)\}; \text{ and}$$

calculating the corresponding duration of multimedia object n as:

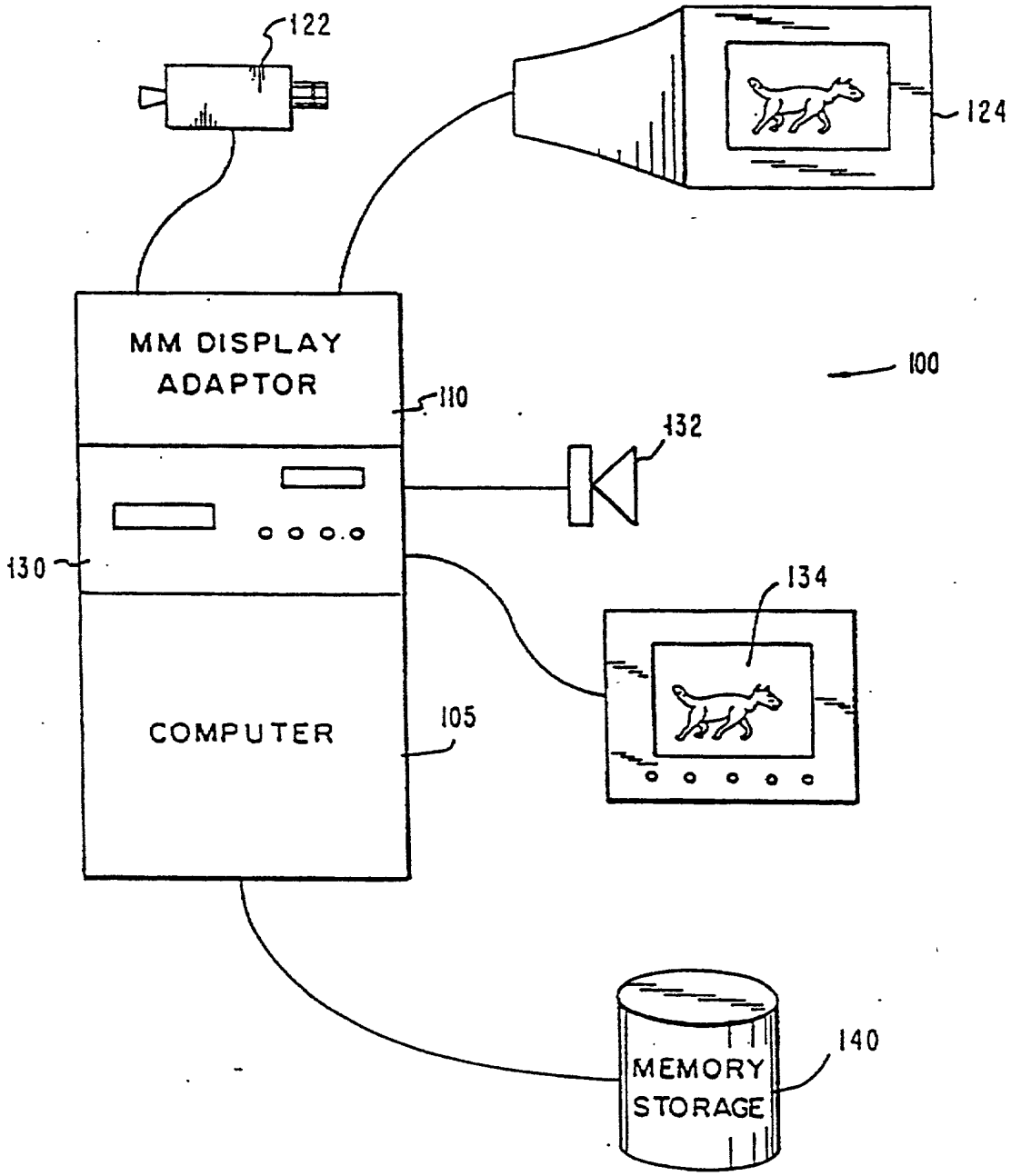
$$\text{duration}(n) = t_x - t_n.$$

PROGRESSIVE ADAPTIVE TIME STAMP RESOLUTION IN MULTIMEDIA AUTHORING

ABSTRACT OF THE DISCLOSURE

Environments with unreliable delivery may result in faltering presentation of multimedia objects, due to missing time stamp deadlines. This may be alleviated by introducing more flexible time stamping. To avoid this, additional MPEG-4 object time information is sent to the client. This requires a new dedicated descriptor, carried in the Elementary Stream Descriptor. The new more flexible timing information will have two features. First, instead of fixed start and end times, the duration of an object can be given a range. And second, the start and end times are made relative to other multimedia object start and end times. This information can then be used by the client to adapt the timing of the ongoing presentation to the environment, while having more room to stay within the presentation author's intent and expectations.

FIG.1


122
124
MM DISPLAY ADAPTOR
110
100
132
130
134
COMPUTER
105
MEMORY STORAGE
140

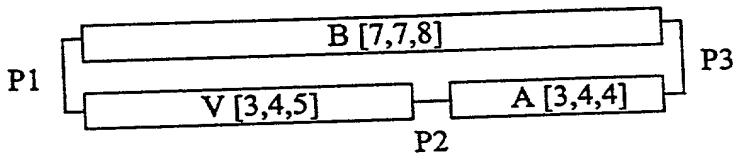


FIG. 2

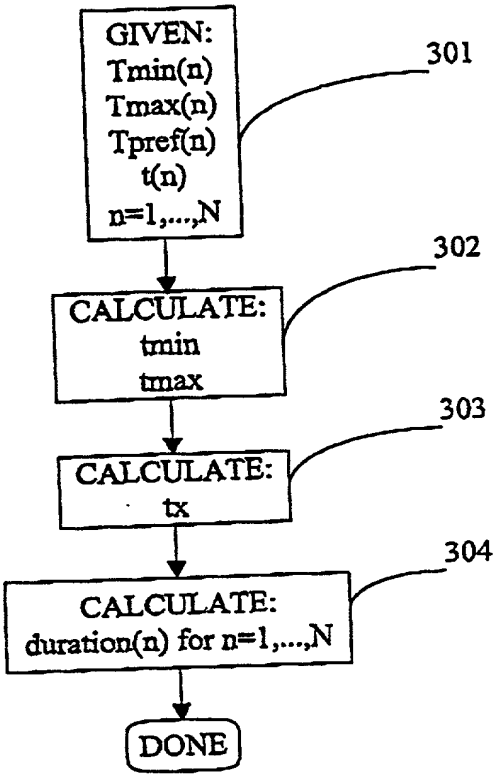


Figure 3

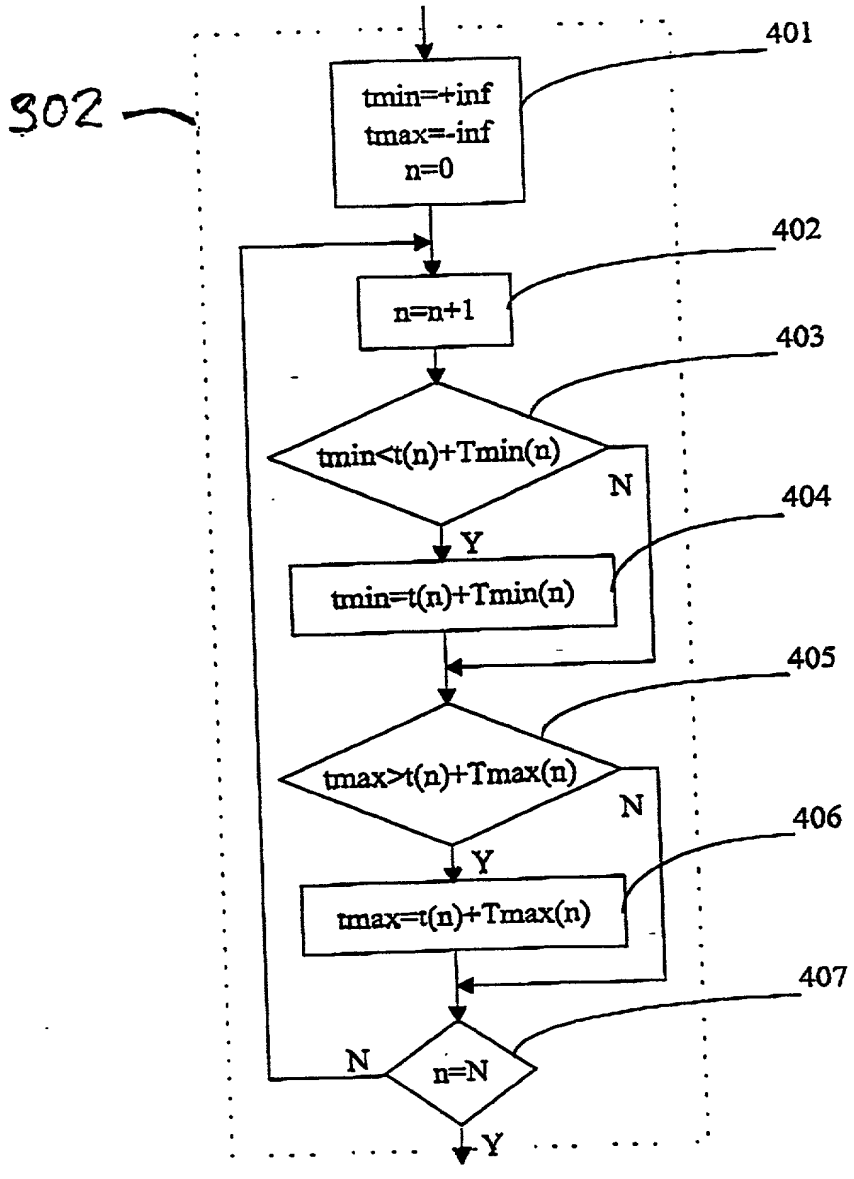

902
401
tmin=+inf
tmax=-inf
n=0
402
n=n+1
403
tmin<t(n)+Tmin(n)
N
Y
404
tmin=t(n)+Tmin(n)
405
tmax>t(n)+Tmax(n)
N
Y
406
tmax=t(n)+Tmax(n)
407
N
n=N
Y

Figure 4

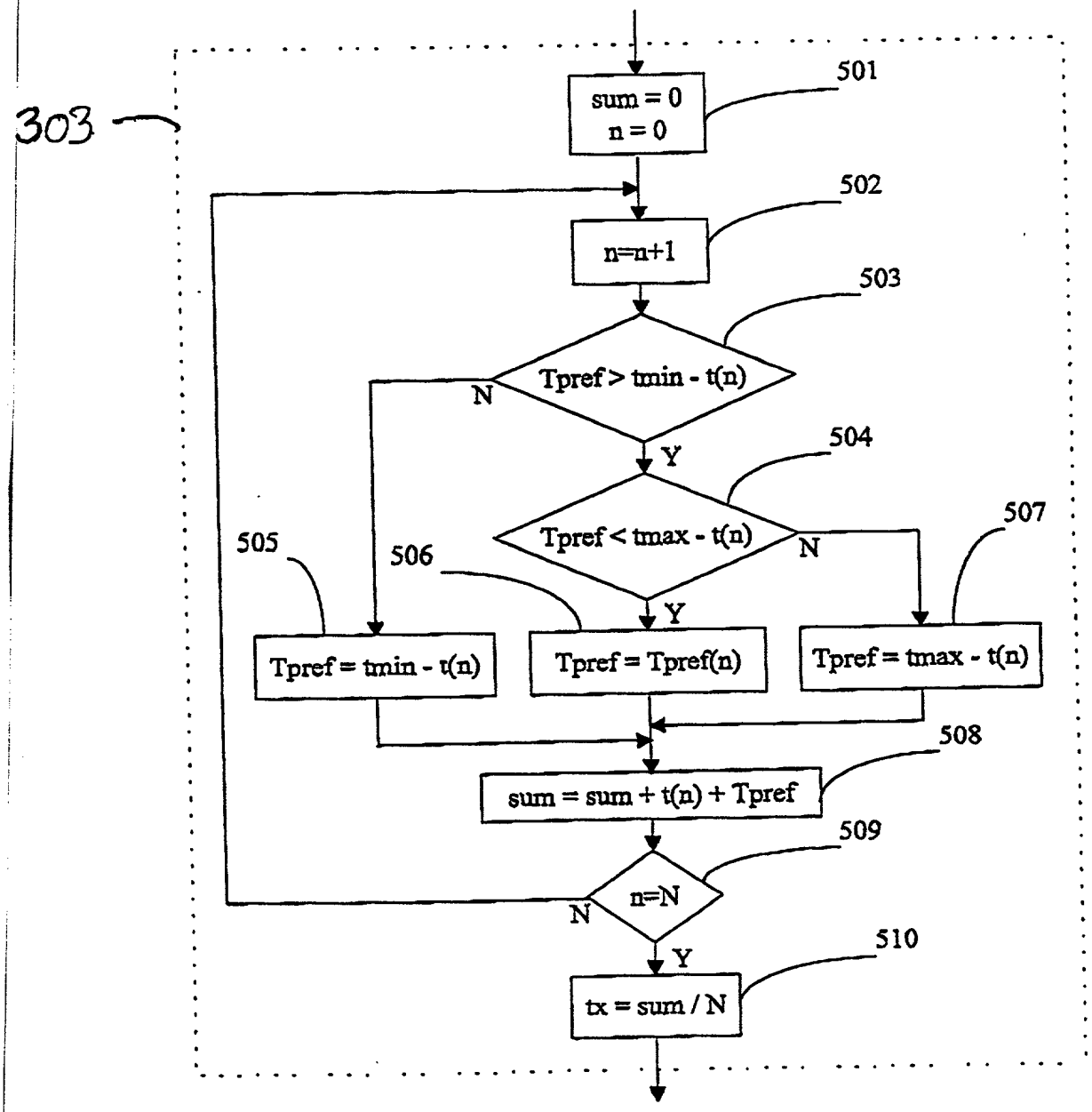

303
sum = 0
n = 0
501
n=n+1
502
Tpref > tmin - t(n)
503
N
Y
Tpref < tmax - t(n)
504
N
Y
505
506
507
Tpref = tmin - t(n)
Tpref = Tpref(n)
Tpref = tmax - t(n)
sum = sum + t(n) + Tpref
508
n=N
509
N
Y
tx = sum / N
510

Figure 5

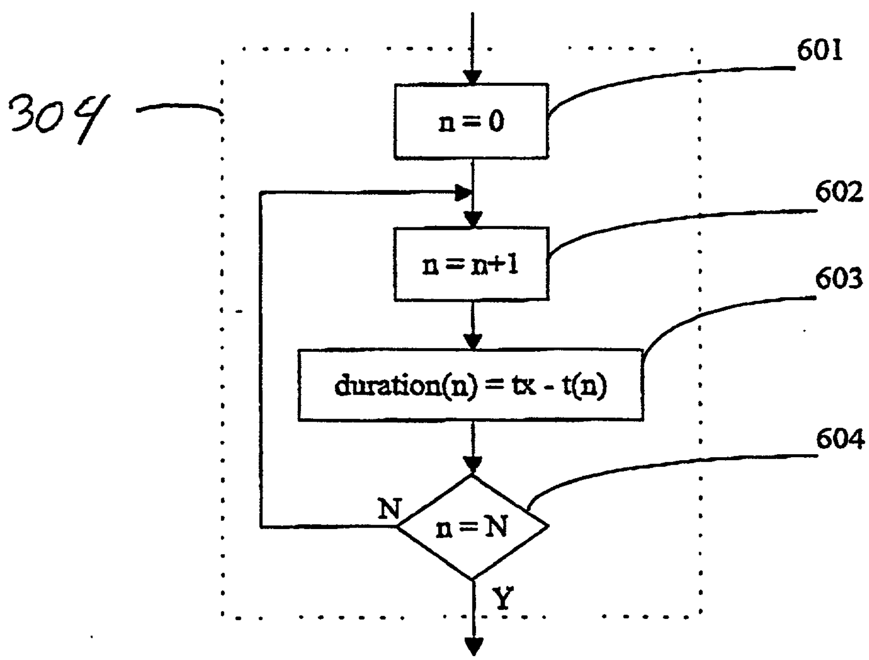


FIG. 6

Docket No.: YO9-98-446

Application for United States Patent
Declaration and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **PROGRESSIVE ADAPTIVE TIME STAMP RESOLUTION IN MULTIMEDIA AUTHORING** the specification of which:

(check one)
- ☒ is attached hereto
- ☐ was filed on _____ as Application Serial No. _____ and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).*

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	yes	no
(Number)	(Country)	(Day/Month/Year Filed)	yes	no

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

60/106,764	11/03/98	Pending Provisional
(Application Serial No.)	(Filing Date)	(Status: patented, pending, abandoned)

Power of Attorney: As a named inventor, I hereby appoint Manny W. Schecter, Reg. No. 31,722, Terry J. Ilardi, Reg. No. 29,936, Stephen C. Kaufman, Reg. No. 29,551, Louis J. Percello, Reg. No. 33,206, Jay P. Sbrollini, Reg. No. 36,266, Robert M. Trepp, Reg. No. 25,933, Daniel P. Morris, Reg. No. 32,053, Kevin P. Jordan, Reg. No. 40,277, Douglas W. Cameron, Reg. No. 31,596, David M. Shofi, Reg. No. 39,835, Christopher A. Hughes, Reg. No. 26,914, Edward A. Pennington, Reg. No. 32,588, John E. Hoel, Reg. No. 26,279, Joseph C. Redmond, Jr., Reg. No 18,753, C. Lamont Whitham, Reg. No. 22,424, Marshall M. Curtis, Reg. No. 33,138, and Michael E. Whitham, Reg. No. 32,635, as attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. All correspondence should be directed to Whitham, Curtis & Whitham, Reston International Center, 11800 Sunrise Valley Drive, Suite 900, Reston, Virginia 20191. Phone calls should be directed to Whitham, Curtis & Whitham, at 703/391-2510.

Docket No.: YO9-98-446

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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*Title 37, Code of Federal Regulations, §1.56(a):
(a) A duty of candor and good faith toward the Patent and Trademark Office rests on the inventor, on each attorney or agent who prepares or prosecutes the application and on every other individual who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application. All such individuals have a duty to disclose to the Office information they are aware of which is material to the examination of the application. Such information is material where there is substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent. The duty is commensurate with the degree of involvement in the preparation or prosecution of the application.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and (1) it establishes, by itself or in combination with other information, a prima facie case of unpatentability; or (2) it refutes, or is inconsistent with, a position the applicant takes in: (i) opposing an argument of unpatentability relied on by the Office, or (ii) asserting an argument of patentability.